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N^o. IX.

An account of the Sugar Maple-tree of the United States, and of the methods of obtaining Sugar from it, together with observations upon the advantages both public and private of this Sugar. In a letter to THOMAS JEFFERSON, Esq. Secretary of the United States, and one of the Vice Presidents of the American Philosophical Society by BENJAMIN RUSH, M. D. Professor of the Institutes and of Clinical Medicine in the University of Pennsylvania.

DEAR SIR,

Read Aug.
19, 1791

IN obedience to your request, I have set down to communicate to our Society through the medium of a letter to you, a short account of the *Sugar Maple-tree* of the United States, together with such facts and remarks as I have been able to collect, upon the methods of obtaining Sugar from it, and upon the advantages both public and private, of this Sugar.

The *Acer Saccharinum* of Linnæus or the Sugar Maple-tree grows in great quantities in the western countries of all the middle states of the American Union. Those which grow in New-York, and Pennsylvania yield the Sugar in a greater quantity than those which grow on the waters of the Ohio.—These trees are generally found mixed with the Beach, (a) Hemlock, (b) white and water ash, (c) the Cucumber tree, (d) Linden, (e) Aspen (f) Butter nut, (g) and wild cherry trees. (h) They sometimes appear in groves covering five or six acres in a body, but they are more commonly interspersed with some or all of the forest trees which have been mentioned. From 30 to 50 trees are generally

(a) *Fagus Ferruginea*. (b) *Pinus abies*. (c) *Fraxinus Americana*. (d) *Magnolia acuminata*. (e) *Tilia Americana*. (f) *Populus tremula*. (g) *Juglans alba (oblonga)*. (h) *Prunus Virginiana*, of Linnæus.

generally found upon an acre of ground. They grow chiefly in the richest soils, and frequently in stony ground. Springs of the purest water abound in their neighbourhood. They are when fully grown as tall as the white and black oaks, and from two to three feet in diameter, * They put forth a beautiful white blossom in the spring before they show a single leaf. The colour of the blossom distinguishes them from the acer rubrum, or the common maple which affords a blossom of a red colour. The wood of the Sugar Maple-tree is of an inflammable nature, and is preferred upon that account by hunters and surveyors for fire wood. Its small branches are so much impregnated with sugar as to afford support to the cattle--horses, and sheep of the first settlers during the winter, before they are able to cultivate forage for that purpose. Its ashes afford a great quantity of pot ash exceeded by few or perhaps by none of the trees that grow in the woods of the United States.

The tree is supposed to arrive at its full growth in the woods in twenty years.

It is not injured by tapping; on the contrary, the oftener it is tapped, the more syrup is obtained from it. In this respect it follows the law of animal secretion. A single tree has not only survived, but flourished after *forty-two* tappings in the same number of years. The effects of a yearly discharge of sap from the tree in improving and increasing the sap is demonstrated from the superior excellence of those trees which have been perforated in an hundred places, by a small wood-pecker which feeds upon the sap. The trees after having been wounded in this way distil the remains of their juice on the ground, and afterward acquire a black colour. The sap of these trees is much sweeter to the taste than that which is obtained from trees

VOL. III.

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which

* Baron LaHontan, in his voyage to North America gives the following account of the Maple tree in Canada. After describing the black Cherry tree some of which he says are as tall as the loftiest oaks and as big as a hog's head, he adds "The Maple tree is much of the same height and bulk. It bears no resemblance to that sort we have in Europe."

which have not been previously wounded, and it affords more sugar.

From twenty three gallons and one quart of sap procured in twenty hours from only two of these dark coloured trees, Arthur Noble, Esq. of the state of New-York obtained four pounds and thirteen ounces of good grained sugar.

A tree of an ordinary size yields in a good season from twenty to thirty gallons of sap, from which are made from five to six pounds of sugar. To this, there are sometimes remarkable exceptions. Samuel Low, Esq. a Justice of Peace in Montgomery County, in the state of New-York informed Arthur Noble, Esq. that he had made twenty pounds, and one ounce of sugar between the 14th and 23d of April in the year 1789. from a single tree that had been tapped for several successive years before.

From the influence which culture has upon forest and other trees, it has been supposed, that by transplanting the Sugar Maple tree into a garden, or by destroying such other trees as shelter it from the rays of the sun, the quantity of the sap might be increased and its quality much improved. I have heard of one fact which favours this opinion. A farmer in Northampton County in the state of Pennsylvania, planted a number of these trees above twenty years ago in his meadow, from *three* gallons of the sap of which he obtains every year a pound of sugar. It was observed formerly that it required five or six gallons of the sap of the trees which grow in the woods to produce the same quantity of sugar.

The sap distils from the *wood* of the tree: Trees which have been cut down in the winter for the support of the domestic animals of the new settlers, yield a considerable quantity of sap as soon as their trunks and limbs feel the rays of the sun in the spring of the year.

It is in consequence of the sap of these trees being equally diffused through every part of them, that they live three years after they are *girdled*, that is, after a circular incision is made through the bark into the substance of the tree for the purpose of destroying it.

It is remarkable that grass thrives better under this tree in a meadow, than in situations exposed to the constant action of the sun.

The season for tapping the trees is in February, March and April according to the weather which occurs in these months.

Warm days and frosty nights are most favorable to a plentiful discharge of sap. *The quantity obtained in a day from a tree, is from five gallons to a pint, according to the greater or less heat of the air. Mr. Low, informed Arthur Noble, Esq. that he obtained near three and twenty gallons of sap in one day (April 14, 1789,) from the single tree which was before mentioned. Such instances of a profusion of sap in single trees are however not very common.

There is always a suspension of the discharge of sap in the night if a frost succeed a warm day. The perforation in the tree is made with an ax or an auger. The latter is preferred from experience of its advantages. The auger is introduced about $\frac{3}{4}$ of an inch, and in an ascending direction (that the sap may not be frozen in a slow current in the mornings or evenings) and is afterwards deepened gradually to the extent of two inches. A spout is introduced about half an inch into the hole, made by this auger and projects from three to twelve inches from the tree.

I 2

The

* The influence of the weather in increasing and lessening the discharge of the sap from trees is very remarkable.

Dr. Tonge supposed long ago (Philosophical Transactions No. 68) that changes in the weather of *every kind* might be better ascertained by the discharge of sap from trees than by weather glasses. I have seen a journal of the effects of heat, cold, moisture, drought and thunder upon the discharges from the sugar trees, which disposes me to admit Dr. Tonge's opinion.

The spout is generally made of the *Shumach or †Elder, which generally grow in the neighbourhood of the sugar trees. The tree is first tapped on the *South* side; when the discharge of its sap begins to lessen, an opening is made on its *North* side, from which an increased discharge takes place. The sap flows from four to six weeks, according to the temperature of the weather. Troughs large enough to contain three or four gallons made of white pine, or white ash, or of dried water ash, aspen, linden, ‡poplar or common maple, are placed under the spout, to receive the sap, which is carried every day to a large receiver, made of either of the trees before mentioned. From this receiver it is conveyed, after being strained, to the boiler.

To preserve the sap from rain and impurities of all kinds, it is a good practice to cover the troughs with a concave board, with a hole in the middle of it.

It remains yet to be determined whether some artificial heat may not be applied so as to increase the quantity and improve the quality of the sap. Mr. Noble informed me, that he saw a tree, under which a farmer had accidentally burnt some brush, which dropped a thick heavy syrup resembling Melasses. This fact may probably lead to something useful hereafter.

During the remaining part of the spring months, as also in the summer, and in the beginning of autumn, the maple tree yields a thin sap, but not fit for the manufactory of sugar. It affords a pleasant drink in harvest, and has been used instead of rum, in some instances by those farmers in Connecticut, whose ancestors have left to them here, and there, a sugar maple tree, (probably to shade their cattle,) in all their fields. Mr. Bruce describes a drink of the same kind, prepared by the inhabitants of Egypt, by infusing the sugar cane in water, which he declares to be “the most refreshing drink in the world.”* There

* Rhus. † Sambucus canadensis. ‡ Liriodendrum Tulipifera.

• Baron La-Hontan, gives the following account of the sap of the sugar maple tree, when used

There are three methods of reducing the sap to fugar.

1. By *freezing it*. This method has been tried for many years, by Mr. Obediah Scott, a farmer in Luzerne county, in this state, with great success. He says that one half of a given quantity of sap reduced in this way, is better than one third of the same quantity, reduced by boiling. If the frost should not be intense enough, to reduce the sap to the graining point, it may afterwards be exposed to the action of the fire for that purpose.

2. By *spontaneous evaporation*. The hollow stump of a maple-sugar tree, which had been cut down in the spring, and which was found sometime afterward filled with sugar, first suggested this method of obtaining sugar to our farmers. So many circumstances of cold and dry weather, large and flat vessels, and above all so much time are necessary to obtain sugar, by either of the above methods, that the most general method among our farmers is to obtain it.
3. by *boiling*. For this purpose the following facts which have been ascertained by many experiments, deserve attention.

1. The sooner the sap is boiled, after it is collected from the tree, the better. It should never be kept longer than twenty-four hours before it is put over the fire.

2. The larger the vessel in which the sap is boiled, the more sugar is obtained from it.

3. A copper vessel affords a sugar of a fairer colour than an iron vessel.

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used as a drink, and of the manner of obtaining it. "The tree yields a sap which has a much pleasanter taste than the best lemonade or cherry water, and makes the wholesomest drink in the world. This liquor is drawn by cutting the tree two inches deep in the wood, the cut being made sloping to the length of ten or twelve inches, at the lower end of this gash a knife is thrust into the tree slopingly, so that the water runs along the cut or gash, as through a gutter and falls upon the knife, which has some vessels placed underneath to receive it. Some trees will yield five or six bottles of this water in a day, and some inhabitants of Canada, might draw twenty hogheads of it in one day, if they would thus cut and notch all the maple trees of their respective plantations. The gash does no harm to the tree. Of this sap they make fugar and syrup, which is so valuable that there can be no better remedy for fortifying the stomach, 'tis but few of the inhabitants that have the patience to make them, for as common things are slighted, so there are scarce any body but children that give themselves the trouble of gashing these trees."

The sap flows into wooden troughs from which it is carried and poured into store troughs or large cisterns in the shape of a canoe or large manger made of white ash, linden, bass wood, or white pine, from which it is conveyed to the kettle in which it is to be boiled. These cisterns as well as the kettle are generally covered by a shed to defend the sap from the rain. The sugar is improved by straining the sap through a blanket or cloth, either before or after it is half boiled. Butter, hogs lard or tallow are added to the sap in the kettle to prevent its boiling over, and lime, eggs or new-milk are mixed with it in order to clarify it. I have seen clear sugar made without the addition of either of them. A spoonfull of slacked lime, the white of one egg and a pint of new-milk are the usual proportions of these articles which are mixed with fifteen gallons of sap. In some samples which I have lately seen of maple-sugar clarified with each of the above articles, that in which milk alone was used, had an evident superiority in point of colour.

The sugar after being sufficiently boiled, is *grained* and *clayed* and afterwards *refined*, or converted into loaf sugar. The methods of conducting each of these processes is so nearly the same with those which are used in the manufactory of West-India sugar, and are so generally known, that I need not spend any time in describing them.

It has been a subject of inquiry whether the maple sugar might not be improved in its quality and increased in its quantity by the establishment of boiling houses in the sugar maple country to be conducted by associated labor. From the scattered situation of the trees, the difficulty of carrying the sap to a great distance, and from the many expenses which must accrue from supporting labourers and horses in the woods in a season of the year in which nature affords no sustenance to man or beast, I am disposed to believe that the most productive method both in quantity and profit of obtaining this sugar will be by the labor of private families

families. For a great number of years many hundred private families in New-York and Pennsylvania have supplied themselves plentifully with this sugar during the whole year. I have heard of many families who have made from two to four hundred pounds in a year; and of one man who sold six hundred pounds all made by his own hands in one season.*

Not more knowledge is necessary for making this sugar than soap, cyder, beer, sour trout, &c. and yet one or all of these are made in most of the farm houses of the United States. The kettles and other utensils of a farmer's kitchen, will serve most of the purposes of making sugar, and the time required for the labor, (if it deserves that name) is at a season when it is impossible for the farmer to employ himself in any species of agriculture. His wife and all his children above ten years of age, moreover may assist him in this business, for the profit of the weakest of them is nearly equal to that of a man when hired for that purpose.

A comparative view of this sugar has been frequently made with the sugar which is obtained from the West-India sugar cane, with respect to its *quality price*, and the possible or probable *quantity* that can be made of it in the United States, each of which I shall consider in order.

1. The *quality* of this sugar is necessarily better than that which is made in the West-Indies. It is prepared in a season when not a single insect exists to feed upon it, or to mix its excrements with it, and before a particle of dust or of the pollen of plants can float in the air. The same observation cannot be applied to the West-India sugar. The
insects

* The following receipt published by William Cooper, Esq. in the Albany Gazette fully establishes this fact.

"Received Cooper's Town April 30th 1790, of William Cooper, sixteen pounds, for six hundred, and forty pounds of sugar made with *my own hands*, without any assistance in less than four weeks besides attending to the other business of my farm, as providing fire wood, taking care of the cattle, &c. John Nicholls, witness R. Smith.

A single family consisting of a man and his two sons on the maple sugar lands between the Delaware and Susquehanna made 1800lb of maple sugar in one season.

insects and worms which prey upon it, and of course mix with it, compose a page in a nomenclature of natural history. I shall say nothing of the hands which are employed in making sugar in the West-Indies but, that men who work for the exclusive benefit of others, are not under the same obligations to keep their persons clean while they are employed in this work, that men women and children are, who work exclusively for the benefit of *themselves*, and who have been educated in the habits of cleanliness. The superior purity of the maple sugar is farther proved by its leaving a less sediment when dissolved in water than the West-India sugar.

It has been supposed that the maple sugar is inferior to the West-India sugar in *strength*. The experiments which led to this opinion, I suspect have been inaccurate, or have been made with maple sugar, prepared in a slovenly manner. I have examined equal quantities by weight of both the grained and the loaf sugar, in hyson tea, and in coffee, made in every respect equal by the minutest circumstances that could affect the quality or taste of each of them, and could perceive no inferiority in the strength of the maple sugar. The liquors which decided this question were examined at the same time, by Alexander Hamilton, Esq. Secretary of the treasury of the United States, Mr. Henry Drinker, and several Ladies, who all concurred in the above opinion.

2. Whoever considers that the gift of the sugar maple trees is from a benevolent Providence, that we have many millions of acres in our country covered with them, that the tree is improved by repeated tappings, and that the sugar is obtained by the frugal labor of a farmer's family, and at the same time considers the labor of cultivating the sugar cane, the capitals sunk in sugar works, the first cost of slaves and cattle, the expenses of provisions for both of them, and in some instances the additional expense
of

of conveying the sugar to a market, in all the West-India Islands, will not hesitate in believing that the maple sugar may be manufactured much cheaper, and sold at a *less price* than that which is made in the West-Indies.

3. The resources for making a sufficient *quantity* of this sugar not only for the consumption of the United States, but for exportation, will appear from the following facts. There are in the states of New-York, and Pennsylvania alone at least ten millions of acres of land which produce the sugar maple-tree; in the proportion of thirty trees to one acre. Now supposing all the persons capable of labor in a family to consist of three, and each person to attend 150 trees and each tree to yield 5lb of sugar in a season, the product of the labor of 60,000 families would be 135,000,000 pounds of sugar, and allowing the inhabitants of the United States to compose 600,000 families each of which consumed 200 pounds of sugar in a year, the whole consumption would be 120,000,000 pounds in a year, which would leave a balance of 15,000,000 pounds for exportation. Valuing the sugar at $\frac{6}{8}$ of a dollar per pound the sum saved to the United States would be 8,000,000 dollars by home consumption and the sum gained by exportation would be 1,000,000 dollars. The only part of this calculation that will appear improbable is, the number of families supposed to be employed in the manufactory of the sugar, but the difficulty of admitting this supposition will vanish when we consider, that double that number of families are employed every year in making cyder, the trouble, risks and expences of which are all much greater than those of making maple sugar.

But the profit of the Maple tree is not confined to its sugar. It affords an agreeable Molasses, and an excellent Vinegar. The sap which is suitable for these purposes is obtained after the sap which affords the sugar has ceased to flow, so that the manufactories of these different products of the maple tree, by *succeeding*, do not interfere with each

other. The Molasses may be made to compose the basis of a pleasant summer beer. The sap of the Maple is moreover capable of affording a spirit, but we hope this precious juice will never be prostituted by our citizens to this ignoble purpose. Should the use of sugar in diet become more general in our country, it may tend to lessen the inclination or supposed necessity for spirits, for I have observed a relish for sugar in diet to be seldom accompanied by a love for strong drink. It is the sugar which is mixed with tea which makes it so generally disagreeable to drunkards. But a diet consisting of a plentiful mixture of sugar has other advantages to recommend it which I shall briefly enumerate.

1. Sugar affords the greatest quantity of nourishment in a given quantity of matter of any substance in nature; of course it may be preserved in less room in our houses, and may be consumed in less time, than more bulky and less nourishing aliment. It has this peculiar advantage over most kinds of aliment, that it is not liable to have its nutritious qualities affected by time or the weather, hence it is preferred by the Indians in their excursions from home. They mix a certain quantity of maple sugar, with an equal quantity of Indian corn, dried and powdered, in its milky state. This mixture is packed in little baskets, which are frequently wetted in travelling, without injuring the sugar. A few spoonfulls of it mixed with half a pint of spring water, afford them a pleasant and strengthening meal. From the degrees of strength and nourishment, which are conveyed into animal bodies by a small bulk of sugar, I conceive it might be given to horses with great advantage, when they are used in places or under circumstances which make it difficult or expensive to support them, with more bulky or weighty aliment. A pound of sugar with grass or hay, I have been told, has supported the strength and spirits of an horse, during a whole day's labor

bor in one of the West-India Islands. A larger quantity given alone, has fattened horses and cattle, during the war before last in Hispaniola, for a period of several months, in which the exportation of sugar, and the importation of grain, were prevented by the want of ships.

2. The plentiful use of sugar in diet, is one of the best preventatives that has ever been discovered of the diseases which are produced by worms. Nature seems to have implanted a love for this aliment in all children, as if it were on purpose to defend them from those diseases. I know a gentleman in Philadelphia, who early adopted this opinion, and who by indulging a large family of children, in the use of sugar, has preserved them all from the diseases usually occasioned by worms.

3. Sir John Pringle, has remarked that the plague has never been known in any country where sugar composes a material part of the diet of the inhabitants. I think it probable that the frequency of malignant fevers of all kinds has been lessened by this diet, and that its more general use would defend that class of people, who are most subject to malignant fevers from being so often affected by them.

4. In the numerous and frequent disorders of the breast, which occur in all countries, where the body is exposed to a variable temperature of weather, sugar affords the basis of many agreeable remedies. It is useful in weaknesses, and acrid defluxions upon other parts of the body. Many facts might be adduced in favor of this assertion. I shall mention only one, which from the venerable name of the person, whose case furnished it, cannot fail of commanding attention and credit. Upon my inquiring of Dr. Franklin, at the request of a friend, about a year before he died, whether he had found any relief from the pain of the stone, from the Blackberry Jam, of which he took large quantities, he told me that he had, but that he believed the medicinal part of the jam, resided wholly in the su-

gar, and as a reason for thinking so, he added, that he often found the same relief, by taking about half a pint of a syrup, prepared by boiling a little brown sugar in water, just before he went to bed, that he did from a dose of opium. It has been supposed by some of the early physicians of our country, that the sugar obtained from the maple tree, is more medicinal, than that obtained from the West-India sugar cane, but this opinion I believe is without foundation. It is preferable in its qualities to the West-India sugar only from its superior *cleanliness*.

Cases may occur in which sugar may be required in medicine, or in diet, by persons who refuse to be benefited, even indirectly by the labor of slaves. In such cases, the innocent maple sugar will always be preferred.*

It has been said, that sugar injures the teeth, but this opinion now has so few advocates, that it does not deserve a serious refutation.

To transmit to future generations, all the advantages which have been enumerated from the maple tree, it will be necessary to protect it by law, or by a bounty upon the maple sugar, from being destroyed by the settlers in the maple country, or to transplant it from the woods, and cultivate it in the old and improved parts of the United States. An orchard consisting of 200 trees, planted upon a common farm, would yield more, than the same number of apple trees, at a distance from a market town. A full grown tree in the woods yields five pounds of sugar a year. If a greater exposure of a tree to the action of the sun, has the same effects upon the maple, that it has upon other trees, a larger quantity of sugar might reasonably be expected from each tree planted in an orchard. Allowing it to

* Dr. Knowles, a physician of worthy character in London, had occasion to recommend a diet to a patient, of which sugar composed a material part. His patient refused to submit to his prescription, and gave as a reason for it, that he had witnessed so much of the oppression and cruelty which were exercised upon the slaves, who made the sugar, that he had made a vow never to taste the product of their misery as long as he lived.

to be only seven pounds, then 200 trees will yield 1400 pounds of sugar, and deducting 200 from the quantity for the consumption of the family, there will remain for sale 1200 pounds, which at $\frac{6}{10}$ of a dol. per pound will yield an annual profit to the farmer of 80 dollars. But if it should be found that the shade of the maple does not check the growth of grain any more than it does of grass, double or treble that number of maple trees may be planted on every farm, and a profit proportioned to the above calculation be derived from them. Should this mode of transplanting the means of obtaining sugar be successful, it will not be a new one. The sugar cane of the West-Indies, was brought originally from the East-Indies, by the Portuguese, and cultivated at Madeira, from whence it was transplanted directly or indirectly, to all the sugar islands of the West-Indies.

It were to be wished, that the settlers upon the sugar maple lands, would spare the sugar tree in clearing their lands. On a farm of 200 acres of land, according to our former calculation, there are usually 6,000 maple trees. If only 2,000 of those original and ancient inhabitants of the woods were suffered to remain, and each tree were to afford only five pounds of sugar, the annual profit of such a farm in sugar alone, at the price formerly mentioned, would amount to 666 dollars, 150 dollars of which would probably more than defray all the expences of making it, and allow a plentiful deduction for family use.

According to the usual annual profit of a sugar maple tree, each tree is worth to a farmer, two dollars and $\frac{2}{3}$ of a dollar, exclusive therefore of the value of his farm, the 2000 sugar maple trees alone confer a value upon it of 5333 dollars and $\frac{2}{3}$ of a dollar.

It is said that the sugar trees when deprived of the shelter and support they derive from other forest trees are liable to be blown down, occasioned by their growing in a rich, and of course a loose soil. To obviate this, it will only

only be necessary to cut off some of their branches so as to alter its center of gravity, and to allow the high winds to have an easy passage through them. Orchards of sugar maple trees, which grow with an original exposure of all their parts to the action of the sun will not be liable to this inconvenience.

In contemplating the present opening prospects in human affairs, I am led to expect that a material part of the general happiness which Heaven seems to have prepared for mankind will be derived from the manufactory and general use of maple sugar, for the benefits which I flatter myself are to result from it will not be confined to our own country. They will I hope extend themselves to the interests of humanity in the West-Indies. With this view of the subject of this letter, I cannot help contemplating a sugar maple tree with a species of affection and even veneration, for I have persuaded myself to behold in it the happy means of rendering the commerce and slavery of our African brethren in the sugar Islands as unnecessary, as it has always been inhuman and unjust.*

I shall conclude this letter by wishing that the patronage which you have afforded to the maple sugar as well as the maple tree, by your example † may produce an influence in our country as extensive as your reputation for useful science and genuine patriotism.

From Dear Sir your

Sincere Friend and Obedient Servant,

BENJAMIN RUSH.

* This letter was written before the account of the war which has lately taken place in Hispaniola, between the white people and their slaves, had reached the city of Philadelphia.

† Mr. Jefferson uses no other sugar in his family than that which is obtained from the sugar Maple tree. He has lately planted an orchard of maple trees on his farm in Virginia.

P. S. Since writing the above letter, I have procured through the friendship of M. Henry Drinker a copy of Mr. Botham's account of the method of manufacturing sugar in the East-Indies. It is extracted from the report of the committee of the British privy Council for trade on the subject of the Slave trade. I shall insert in this postscript only such parts of it as will throw light upon the method of manufacturing the maple sugar which has been mentioned and to show how much it is to be preferred in point of œconomy to that which is used in the West-Indies.

Extract from the report of the Committee of Privy Council for trade on the subject of the African Slave trade, &c. To the King, Part 3. No. 3. Mr. Botham on the mode of cultivating a sugar plantation in the East-Indies, &c.

“ **H**AVING been for two years in the English and French West-Indian Islands, and since conducted sugar estates in the East-Indies; before the abolition of the slave trade was agitated in parliament, it may be desirable to know that sugar of a superior quality and inferior price, to that in our Islands, is produced in the East-Indies; that the culture of the cane, the manufacture of the sugar and arrack, is with these material advantages, carried on by free people. China, Bengal, the coast of Malabar, all produce quantities of sugar and spirits; but as the most considerable growth of the cane is carried on near Batavia, I shall explain the improved manner in which sugar estates are there conducted. The proprietor of the estate is generally a wealthy Dutchman, who has erected on it substantial mills, bailing and curing houses. He rents this estate to a Chinese, who resides on it as a superintendant; and this renter (supposing the estate to consist of 300 or
more

more acres) re-lets it to freemen in parcels of 50 or 60 on these conditions.

That they shall plant it in canes, and receive so much per pecul of $133\frac{1}{2}$ lbs. for every pecul of sugar that the canes shall produce.

When crop time comes on, the superindant collects a sufficient number of persons from the adjacent towns or villages, and takes off his crop as follows.

To any set of tradesmen who bring their carts and buffaloes he agrees to give such a price per pecul to cut all his crop of canes, carry them to the mill and grind them.

A second to boil them per pecul.

A third to clay them and basket them for market per pecul.

So that by this method of conducting a sugar estate the renter knows to a certainty what the produce of it will cost him per pecul. He has not any permanent or unnecessary expence; for when the crop is taken off, the taskmen return to their several pursuits in the towns and villages they came from; and there only remains the cane planters who are preparing the next year's crop. This like all other complex arts by being divided into several branches, renders the labour cheaper and the work more perfectly done. Only clayed sugars are made at Batavia: these are in quality equal to the best sort from the West-Indies, and are sold so low from the sugar estates as eighteen shillings sterling per pecul of $133\frac{1}{2}$ lbs. This is not the selling price to the trader at Batavia, as the government there is arbitrary, and sugar subject to duties imposed at will. The Shabander exacts a dollar per pecul on all sugar exported. The price of common labor is from 9d to 10 pence per day. By the method of carrying on the sugar estates, the taskmen gain considerably more than this not only from working extraordinary hours, but from being considered artists in their several branches. They do not make spirits on the
sugar

sugar estates. The Melasses is sent for sale to Batavia where one distillery may purchase the produce of an hundred estates. Here is a vast saving and reduction of the price of spirits; not as in the West-Indies, a distillery, for each estate; many center in one; and arrack is sold at Batavia from 21 to 25 Rix dollars per Leaguer of 160 gallons; say 8d per gallon.

The improvement in making the cane into sugar at Batavia keeps pace with that in its culture. Evaporation being in proportion to the surface, their boilers are set with as much of it as possible; the cane juice with temper sufficient to throw up its impurities is boiled down to the consistence of a syrup; it is then thrown up into vats calculated to hold one boiling, then sprinkled with two buckets of water to subside its foul parts; after standing six hours, it is let off by three pegs of different heights into a single copper with one fire. It is there tempered again boiled up and reduced to sugar, by a gentle fire. It granulates, and the sugar boiler dipping a wand into the copper strikes it on the side, then drops the sugar remaining on it into a cup of water, scrapes it up with his thumb nail, and is by this means able to judge to the utmost necessity of the sugar having its proper degree of boiling: the vats or receivers I mentioned are placed at the left hand of a set of coppers; after running off for boiling all that is clear, the remainder is passed through a strainer, on the outside of the boiling house; what is fine is put into the copper for sugar; the lees are reserved for distilling."